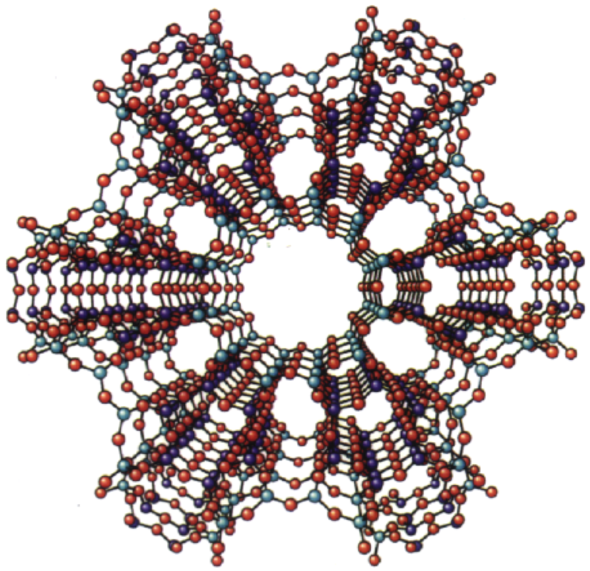
Energy Resources

contributing to an abundant, secure energy supply



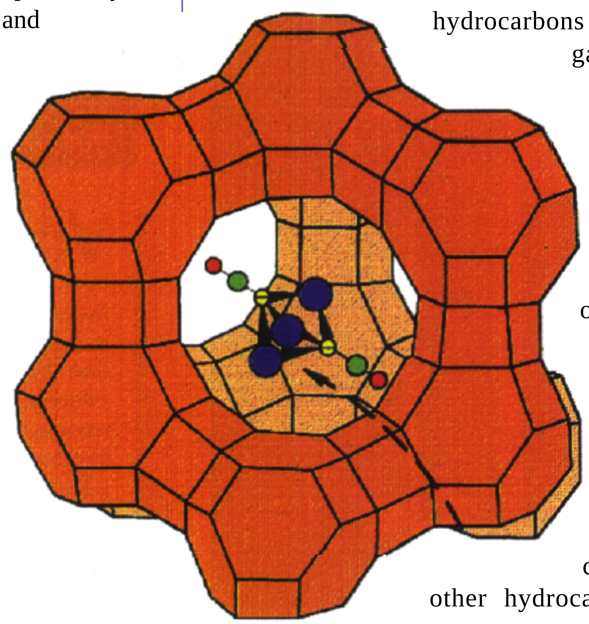
Our nation's largest petroleum and chemical companies (Amoco, Chevron, Dow Chemical, Mobil, and others) are using the BES synchrotron light sources and neutron sources to gather information about the three-dimensional structure of the molecules they use in their manufacturing processes. For example, knowledge about the local environment of specific atoms — such as in this zeolite catalyst-could lead to more efficient petroleum refining.

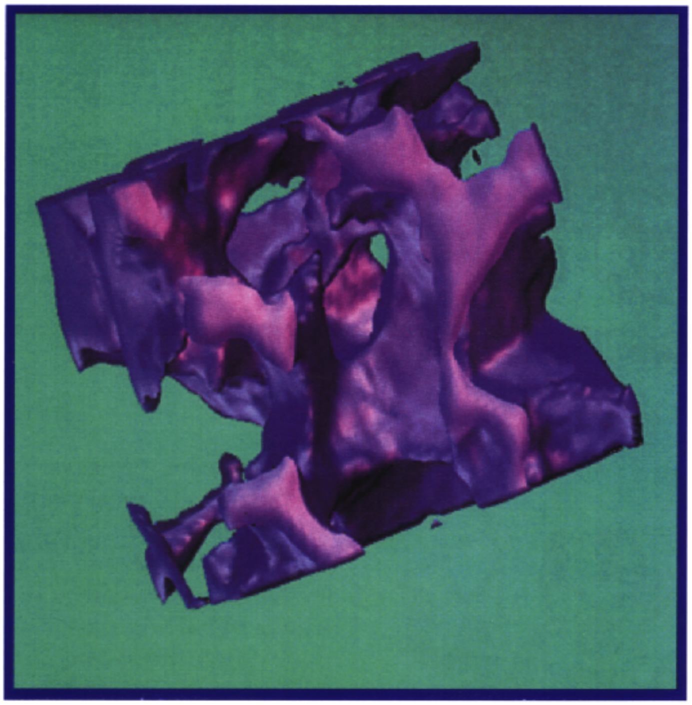
Massive industrial R&D efforts have focused on developing advanced techniques for producing energy and finding more productive ways to tap our existing supplies. BES scientists are also playing an active role in many of these research areas, such as renewable energy research — exemplified by a solar cell with a record high efficiency — and investigations of fossil fuels.

BES researchers are working with petroleum companies to locate new fossil fuel reserves and predict oil reservoir output. However, much of the oil in already-known fields cannot be recovered by conventional techniques. In an effort to make oil recovery operations more effective — thereby enhancing the stewardship of our natural resources — BES is studying the structure of porous rock found in oil fields and developing computer models for the flow of oil through channels in the rock. The petroleum industry, in turn, is using this information to develop additives that enhance the recovery process.

In an effort to make the refining process more efficient, BES researchers are also collaborating with major petroleum producers to develop improved catalysts. For example, BES-funded synchrotron light sources and neutron sources provide industry with the means to determine the structure and fundamental properties of catalyst materials, the precise roles catalysts play in reactions, and how they might be favorably modified.

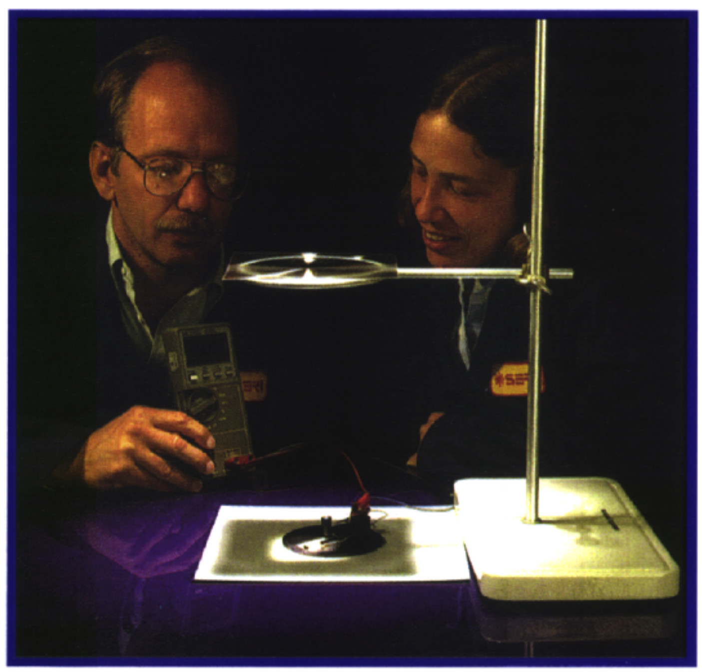
Developing practical industrial processes for converting refining waste products, such as methane gas or petroleum coke, to commercially viable fuels and chemicals is also a compelling economic and environmental goal. For example, a process that could convert methane directly to liquid hydrocarbons or condensable gaseous compounds would overcome the current barriers to using the vast quantities of methane that are presently either capped at the well or wastefully flared into the atmosphere. A BES/industry team has already made significant progress in developing catalysts that have an ability to convert methane to other hydrocarbons.





Fluid Flow in Rock

This X-ray micrograph, made at the National Synchrotron Light Source at Brookhaven National Laboratory, shows the structure and connectivity of porosity in Fontainebleau sandstone found in oil fields. Scientists at Exxon Research and Engineering Company, Schlumberger-Doll, Princeton Materials, and National Institute of Standards and Technology are collaborating to improve their understanding of oil flow within the sandstone and, by extension, the efficiency of managing oil field reservoirs.



Catalytic Clusters

(left page) Scientists at Argonne National Laboratory and Amoco Corporation are working on a more efficient process to convert natural gas into other, more valuable hydrocarbons such as motor fuels. The catalysts that drive the process are made by modifying large-pore, molecular-sieve materials to produce catalytically active molecular clusters (like the one shown in the diagram on the left page). Different varieties of the catalysts can be created by simply changing the pore size of the sieve and adjusting the encapsulated cluster.

Solar Energy

The National Renewable Energy Laboratory recently set a world record for efficiency in a solar cell: 29.5 percent! This achievement has led to a number of collaborations with companies, such as Spectrolab, Spire, and Kopin, who are interested in learning how to fabricate and commercialize this state-of-the-art device.